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Short Report

Relationship between suicidal cases and meteorological conditions

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ABSTRACT

Meteorological factors are well known to modulate human health status and the rate of death cases. The suicidal rate might have been influenced by climatic and seasonal triggering factors. In this study 4918 suicidal cases (3099 male, 1819 female) in Budapest were investigated in connection with climatic data, as daily maximum, minimum temperature, and air humidity. The most frequent methods of suicide were intoxication, hanging and jumping. A mild seasonal variation was found, however, the rate of suicidal death was influenced by warm temperatures. Higher frequency of suicidal deaths was detected in warm weather with low relative humidity, which implies dominantly dry anticyclonic meteorological conditions. Our results suggest that the medico-legal investigation may help specific suicide prevention programme regarding to the climate change and meteorological conditions as potential risk factors of suicidal cases.

1. Introduction

Suicide may have been attributed to several risk factors. There are several intensive investigations related to suicidal methods[1], recognition and social effects[2], clinical treatment of depressive symptoms[3], frequency[4], risk factors of suicidal attempts and fatal suicides. There is a common hypothesis that environmental and climate conditions may influence mortality rates. Climatic and seasonal triggering factors, changes in local weather conditions can modify human behaviour and influence the suicidal rate.[5–8] Recent study[9] results that simple linear regression shows no correlation between suicide and temperature, therefore, it appears that the seasonality of suicides is due to factors other than temperature. However, other epidemiological studies[10–13] found higher suicidal rate in warmer seasons, mainly summer periods. The seasonal effect on mortality by suicide is positively related to suicide rates, so much so that changes in suicide rates over time correspond to changes in suicide seasonality. A study[10] sets out to explore the impact of global warming on suicide mortality. In other study[14] this effect was only evident among females, further pointing towards differences by sex in the mechanics leading to suicide. Increasing anomalies in monthly average temperatures associated to a higher monthly suicide mean from May to August and, to a lower extent.[10]

The relationship between duration of sunshine hours or solar radiation and suicidal death is well established.[11–13] Detection and attribution of health effects and fatal events to climate changes might have become a key research challenge in the future. Characterization of environmental risk factors is important for forensic medicine to determine preventative strategies against the global environmental changes.

The aim of the present study was to analyze the relationship between completed suicide cases and meteorological conditions. Our purpose was to assess the relationship between daily temperature and daily suicide counts in Budapest.

2. Material and methods

2.1. Mortality data sources

The survey target groups included victims of suicidal deaths in Budapest, capital of Hungary, with about 2 million inhabitants. We extracted daily counts of deaths cases. Information was collected from forensic autopsy records. There were 4918 (3099 male, 1819 female) suicidal deaths cases autopsied at the Department of Forensic and Insurance Medicine, Budapest, from 1st January 1995 to 31st December 2004. Data were analyzed according to the types of suicidal methods, gender, and daily meteorological conditions. In every case there was a scene investigation performed by the police. All the cases were autopsied by forensic pathologists. The macroscopic post-mortem investigation was followed by a detailed histological examination in every case. The

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Table 1
Distribution of suicidal methods among males and females.

	Male no. (%)	Female no. (%)	All (100%)
Intoxication	746 (43)	991 (57)	1737
Hanging	1206 (80)	306 (20)	1512
Drowning	61 (60)	40 (40)	101
Gunshot	196 (93)	14 (7)	210
Stab wounds	122 (78)	34 (22)	156
Jumping	486 (58)	346 (42)	832
Others	250 (75)	83 (25)	333
All	3067 (63)	1814 (37)	4881

10th revision of the International Classification of Diseases (ICD) was used for the determination of cause of death.

2.2. Meteorological variables

For the evaluation of meteorological factors two meteorological databases were used: (a) Meteorological data were obtained from the European Centre for Medium-Range Weather Forecast (ECMWF) ERA-40 database between 1st January 1995 and 31st Augustus 2002. (b) For the period between 1st September 2002 and 31st December 2004 database of the urban climate station (installed at the Eötvös Loránd University, Department of Meteorology and maintained by the Hungarian Meteorological Service) was used.

We investigated the meteorological factor related suicidal mortality using Box–Whisker plot histograms for estimating suicidal frequency distribution. We modelled the number of daily suicidal death cases (Nos. 1, 2, 3, 4, or 5), their relationships to daily maximum, minimum and mean temperature. The following meteorological factors were evaluated: daily maximum and minimum temperature (T_{max} and T_{min}, respectively), daily maximum temperature change ($\Delta_{max}T$), daily maximum and minimum temperature at AT-850 hPa geopotential level ($T_{max,850}$ and $T_{min,850}$, respectively).

3. Results and discussion

Climatic and seasonal triggering factors on human life have received an increasing public and social interest for centuries.[15] Suicide may have been attributed to several risk factors. Physicians and meteorologists pay attention on the relationship between the meteorological events and their reactions on human health.

Distribution of suicidal methods is presented in Table 1. Hanging, drowning, stab wounds, gunshot, and jumping were the most frequent suicidal methods among middle age males; however, drug intoxication was detected in the highest number among females in the oldest age group. The following intoxications were most frequent among females: nitrozepam, lidocain, carisoprodol, diclofenac, phenotiazyn, β-blocker, verapamil, propranolol, amitriptylin, closapin. The males preferred other toxic materials to drugs, e.g. pesticide, yellow phosphorus, antifreeze.

Seasonal fluctuation in suicide has been observed in many populations. High temperature may contribute to this. Our results confirmed previous findings[13,16] that seasonal transition may contribute to the pathogenesis of suicide. In our material the most frequent methods, as intoxication, hanging, and jumping were detected more frequently during the summer periods. There is also a rise in the number of suicides due to jumping and intoxication in January. This slight increasing rate might be in connection with the socio-economic conditions following Christmas time. The other methods did not follow seasonal distribution (Fig. 1). The incidence of suicide may display a clear seasonal pattern, being positively linked with prevailing levels of sunlight.[12] Previous publications[17,18] demonstrated a summer maximum and a winter minimum of suicide cases in both genders.

Seasonal affective disorder is especially sensitive to exposure to high-power light, and is more diffuse in northern latitudes, with a peak period for the onset of episodes in the winter months.[7] Mental disorders are reported frequently among the persons completing suicide.[11,19] It seems to be a general teaching that mental disorder occurs more frequently in autumn and winter time and not in spring. However, post mortem studies suggest higher suicidal frequency in summer period than in winter time. Partonen et al.[13] found that the seasonal effect was most pronounced when the number of suicides was relatively low, and the solar and geomagnetic activity was associated with the risk of suicide. Other study has not found spring or summer peak in suicide.[20]

One of the most important meteorological factors is the daily maximum and daily mean temperature. In this study a positive correlation was detected between daily mean temperature and

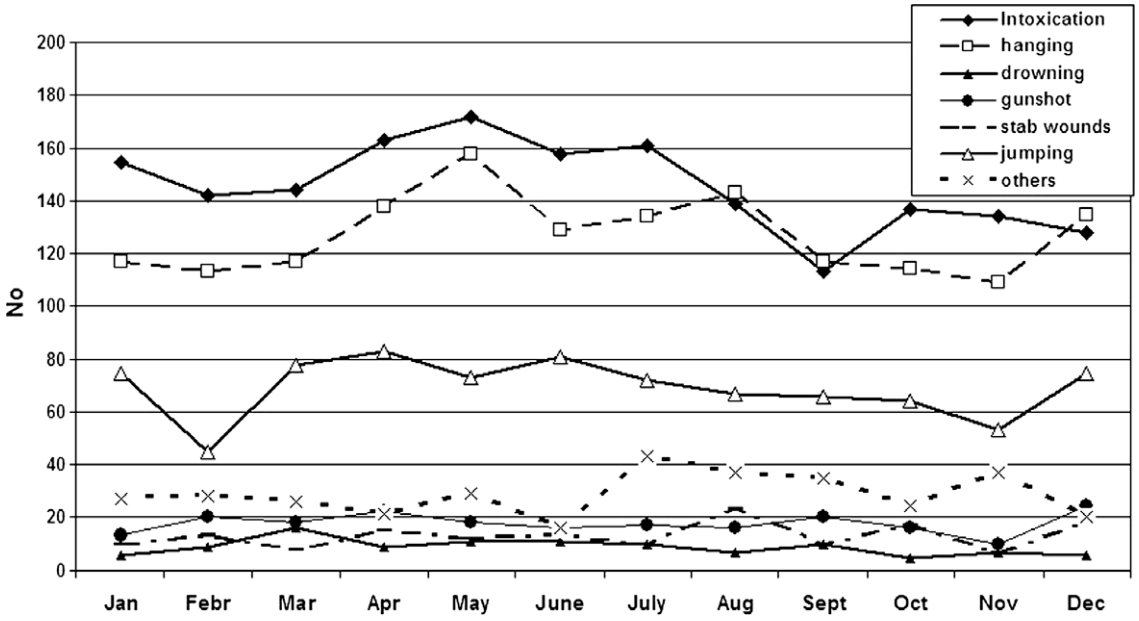

Fig. 1. Seasonal distribution of different suicidal methods.

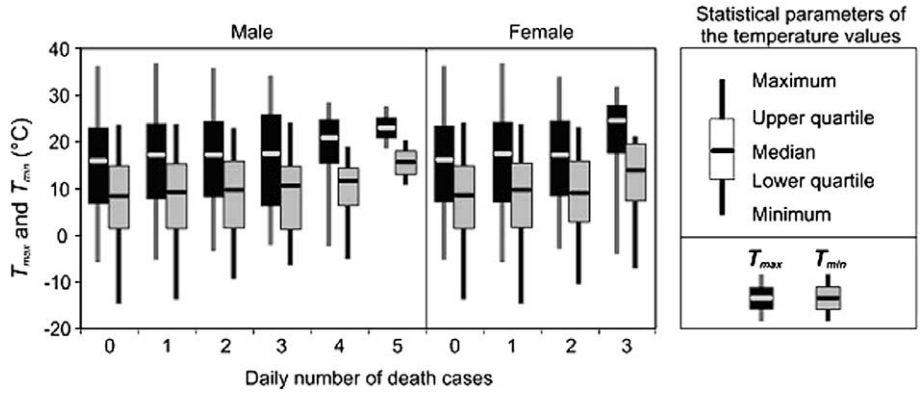

Fig. 2. The total daily number of suicidal death cases depending on the daily maximum and minimum temperature, 2000–2004.

suicide cases. As the number of suicide death events increases, a significant increase in daily maximum temperature was detected. Box–Whisker plot diagrams (Fig. 2) show the daily number of male and female suicidal death cases depending on the daily maximum and minimum temperature. When more suicide death cases occurred during the day, the median value and the quartiles of both the maximum and minimum temperature tended to be larger, which implies dominantly warm meteorological conditions.

The daily number of suicidal death cases depending on the global radiation. When more suicidal death occurred in a day, the solar radiation tends to be larger. In our material it means dominantly clear sky, anticyclonic meteorological conditions. In case of more suicidal death cases, the relative humidity tends to be smaller, which also implies dominantly dry, anticyclonic meteorological conditions.

Page[20] found an increased risk of suicide during hot weather. Above 18 °C, each 1 °C increase in mean temperature was associated with a 3.8% and 5.0% rise in suicide and violent suicide, respectively. In contrast other results represent a novel minor effect in seasonality of suicide, which is hardly compatible with the hypothesized role of temperature in suicide seasonality.[21,22] Effects of weather variables on suicide are well-documented, but there is still little consistency among the results of most studies. Nevertheless, most studies show a peak in suicides during the spring season, and this is often attributed to increased temperatures. Therefore, it appears that the seasonality of suicides is due to factors other than temperature.[9] Preti[7] reported that the number of suicide cases is positively correlated to the geographical latitude. This can be explained by the fact that regions located in northern part, are less exposed to the sun and consequently the mean temperature is lower than in southern regions.

An improvement in the ability of communities to adjust to temperature changes by implementing public health interventions may play an important part in preserving the wellness of the general population, and also in limiting the worst consequences of suicidal behaviour.[10] The findings are of research interest for future studies regarding mechanisms of suicidal behaviour, and also of practical interest for better timing of suicide interventions and effective preventive strategies.[8] Further investigation about the characteristic injuries may help the final determination of violent death causes, and more effort should be directed to the effective prevention strategy.

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